



# **HYPERSENSPECTRAL *IN SITU* SUPPORT FOR PACE (HYPERINSPACE)**

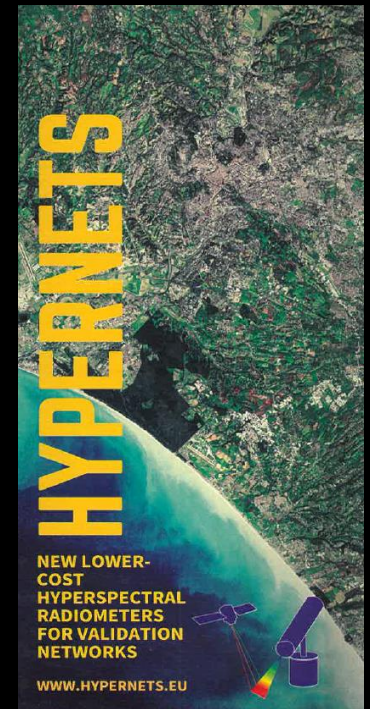
Autonomous above-water radiometry

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Ocean Sciences February 28, 2019

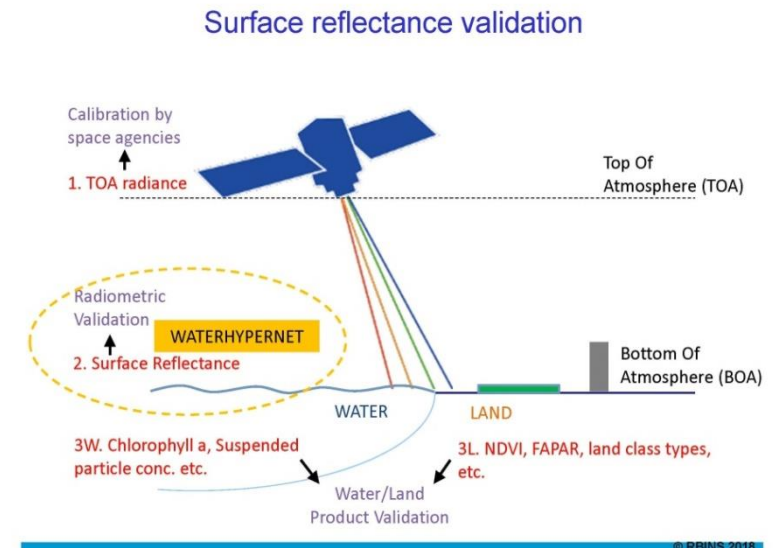


# Quality Data for Cal/Val and Algorithm Development

- Satellite OC imagery, without *in situ* validation = fridge magnets and mouse pads
- AeronetOC-like hyperspectral towers may help
  - Finite & fixed (none planned for US yet)
  - Not yet built
- Autonomous Above-Water Data
  - Ferries, RVs since ~2003
  - Often matched to in-water AOPs/IOPs
  - All conditions and water-types
  - Is it “quality” data?
  - How was it processed?



WATERHYPERNET: A Hyperspectral network for water colour validation. Credit: RBINS.





# Challenges



## Recent NASA Affiliated Cruises with HyperSAS:

- NOAA NESDIS STAR/JPSS/VIIRS - CZCS to present
  - Nov 2014; MAB (Hyperpro, HTSRB, HyperSAS, etc.)
- ECOA
  - June-July 2015; US E. Coast
  - RV Gordon Gunter
- NOAA VIIRS JPSS 2015
  - Dec 2015; MAB, Bahamas
- KORUS
  - May 2016; Korea, East Sea
  - RV Onnuri
- Cyanate
  - Aug 2016; MAB
  - RV Sharp
- Sea-to-Space
  - Jan Feb 2017; E. Pacific
  - RV Falkor
- Po6S
  - July-Sept 2017; Trans-Pacific
  - RV Nathaniel Palmer
- EXPORTS
  - Sept 2018; N.E. Pacific
  - RV Sally Ride
- EXPORTS
  - May 2019; N.E. Atlantic
  - RV Discovery



Thousands of hours/miles of automated collections & counting



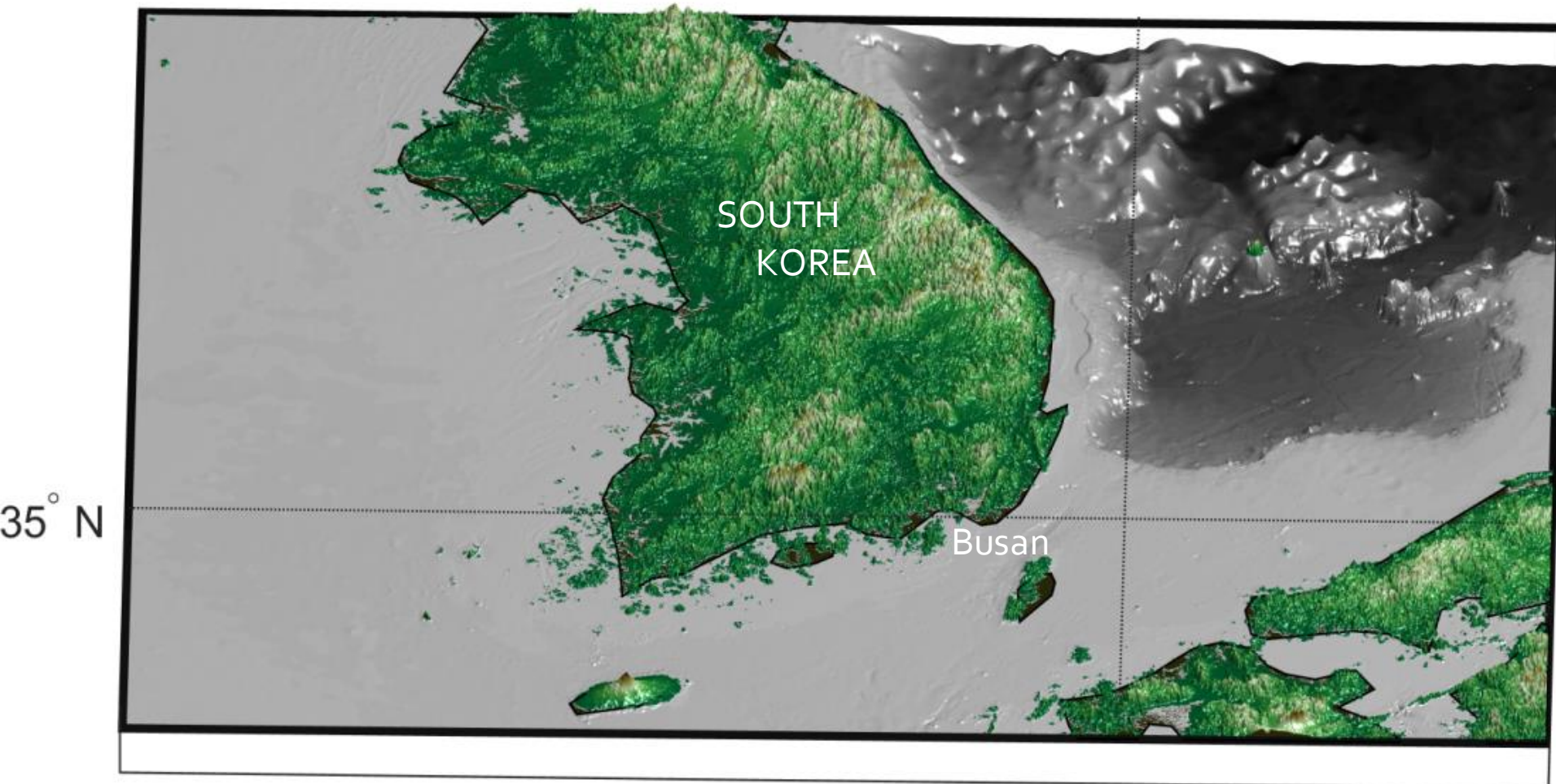
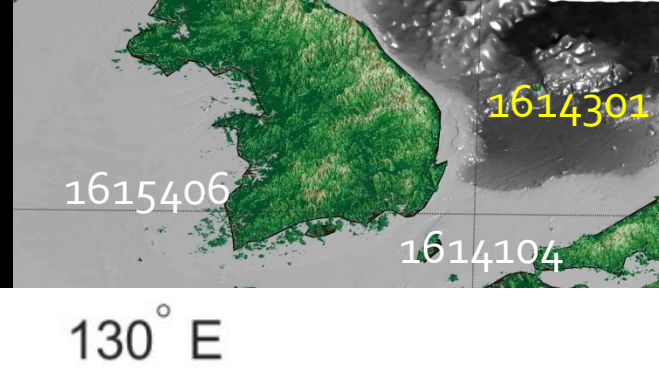
Dirk Aurin; OS2020 San Diego





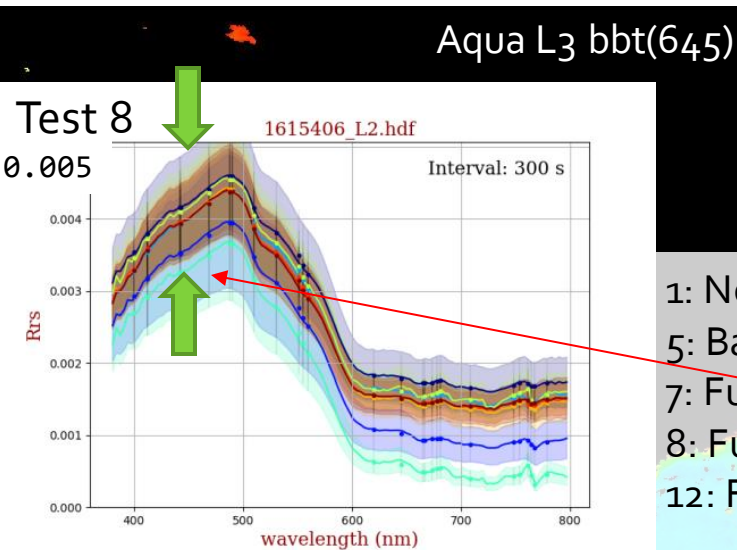
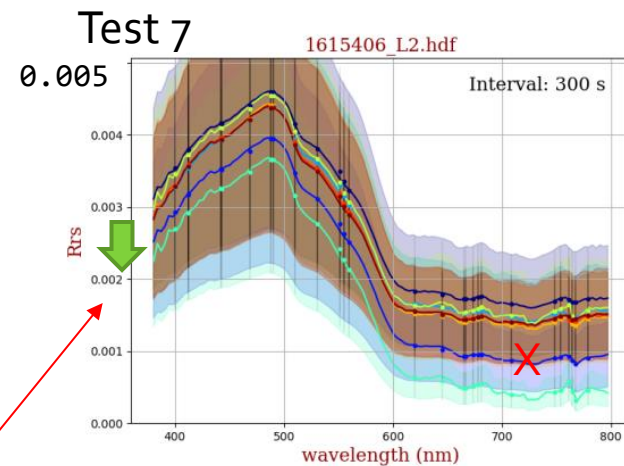
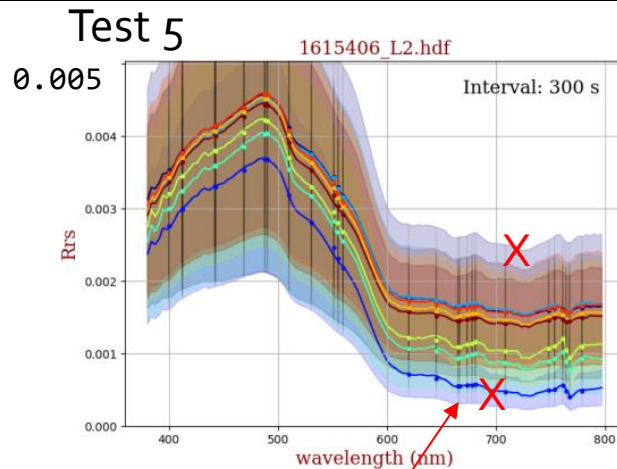
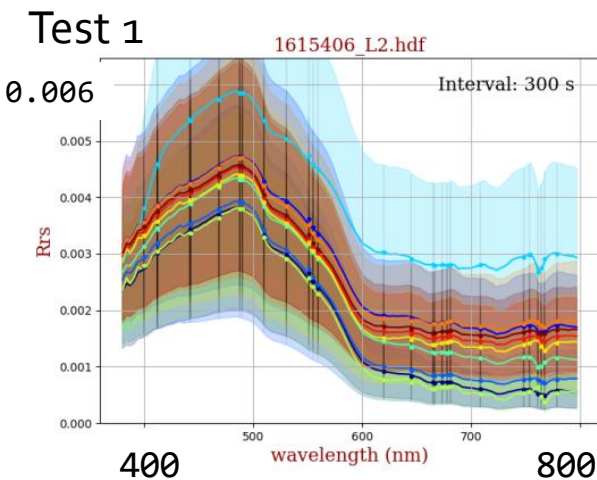
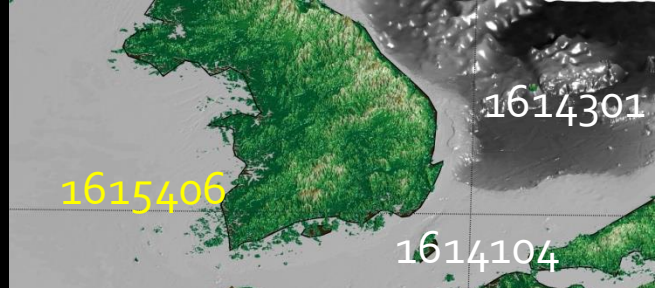
# Preliminary Findings

## KORUS 2016 $R_{rs}(\lambda, t)$



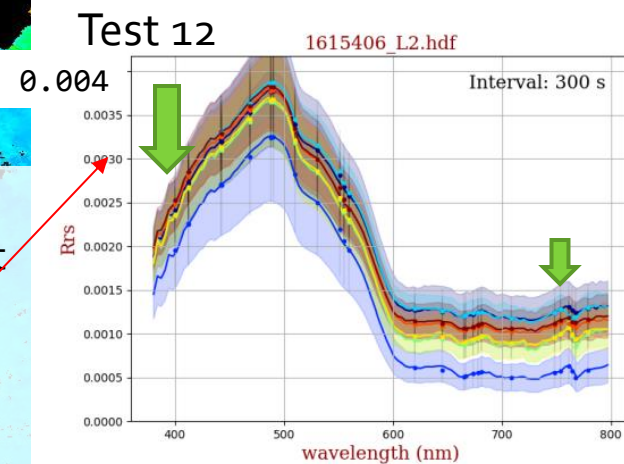


# Underway Data 5 Minute Ensembles

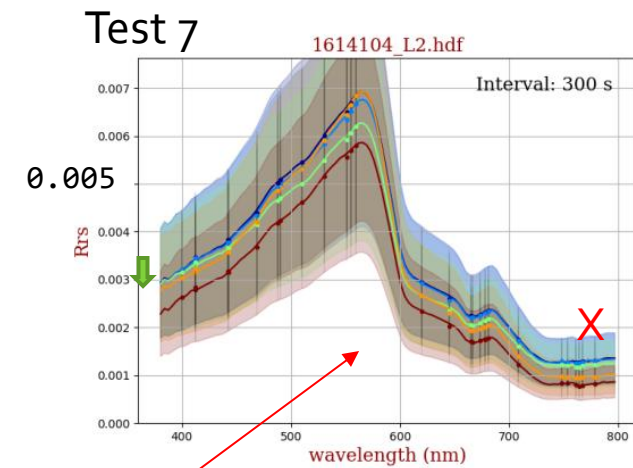
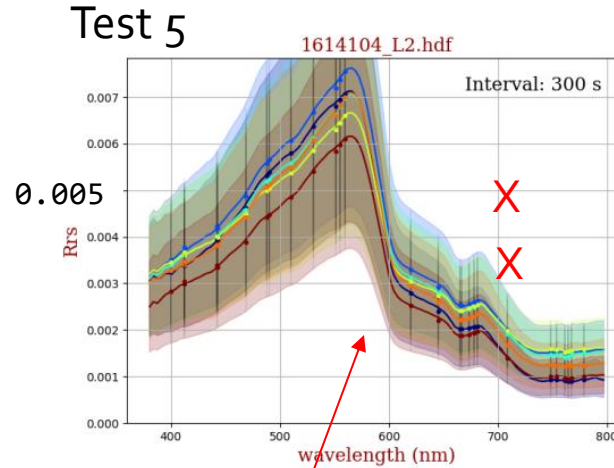
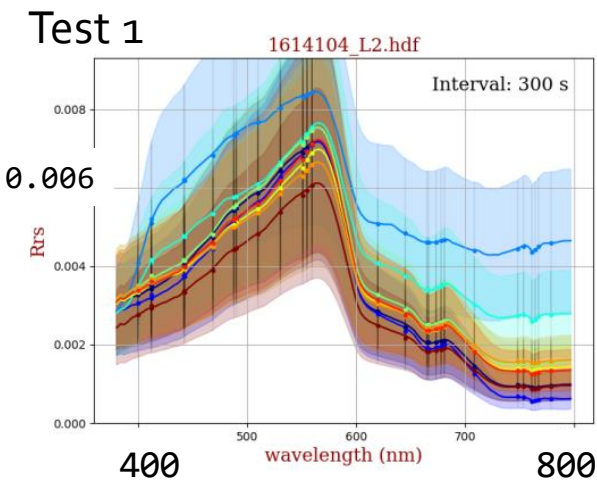
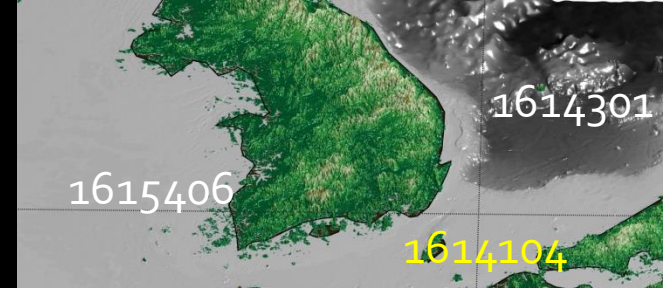


Aqua L3 bbt(645)

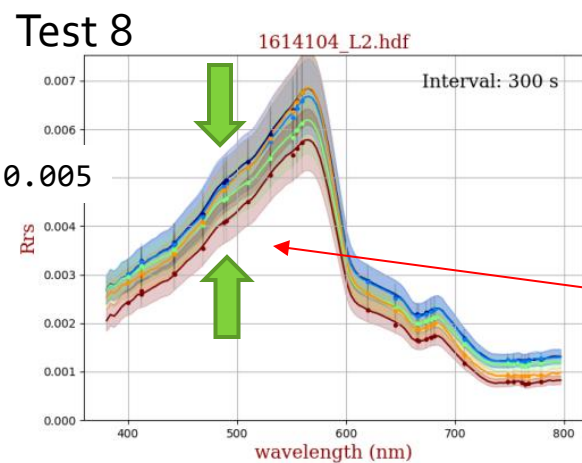
1: No QC + 50% Lt + Mobley Glint  
5: Basic QC + 50% Lt + Mobley Glint  
7: Full QC + 10% Lt + Mobley Glint  
8: Full QC + 10% Lt + Ruddick Glint  
12: Full QC + 10% Lt + Zhang Glint  
+ SimSpec NIR



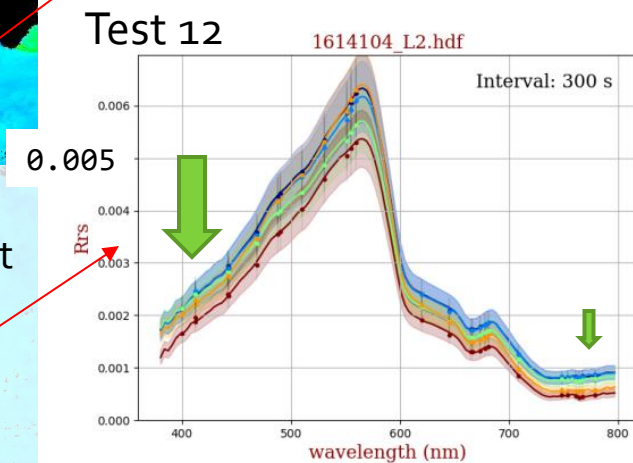
# Processing Improvements



Aqua L3 bbt(645)



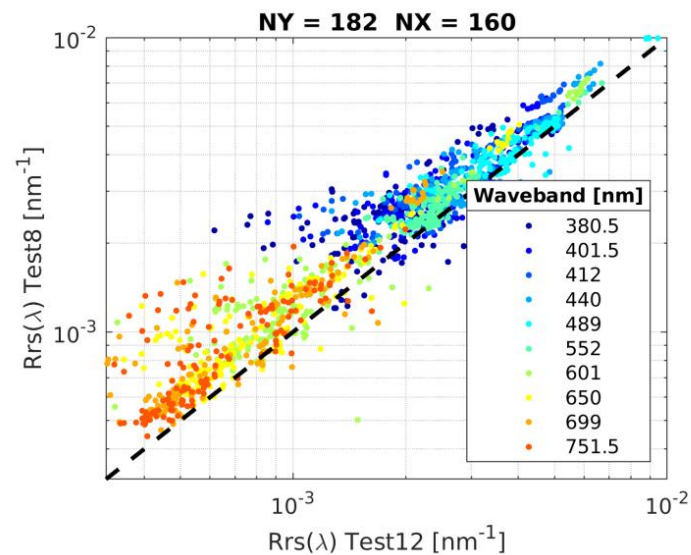
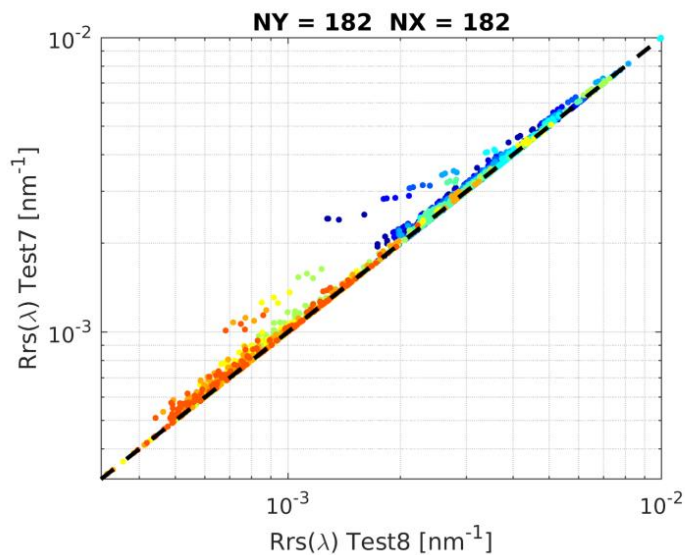
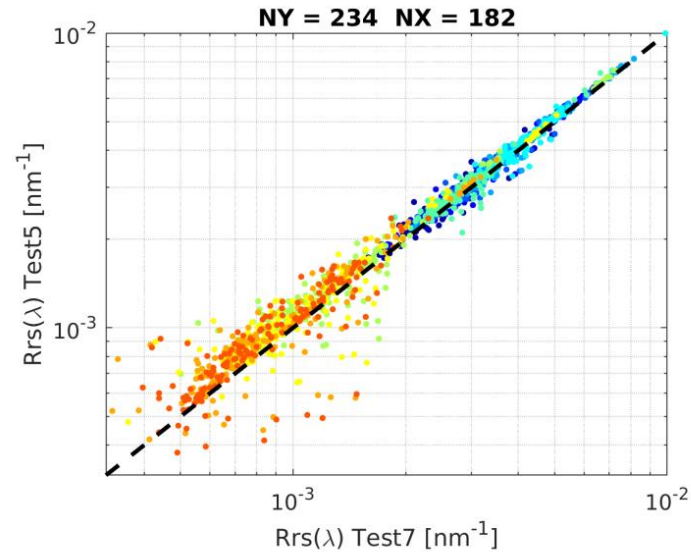
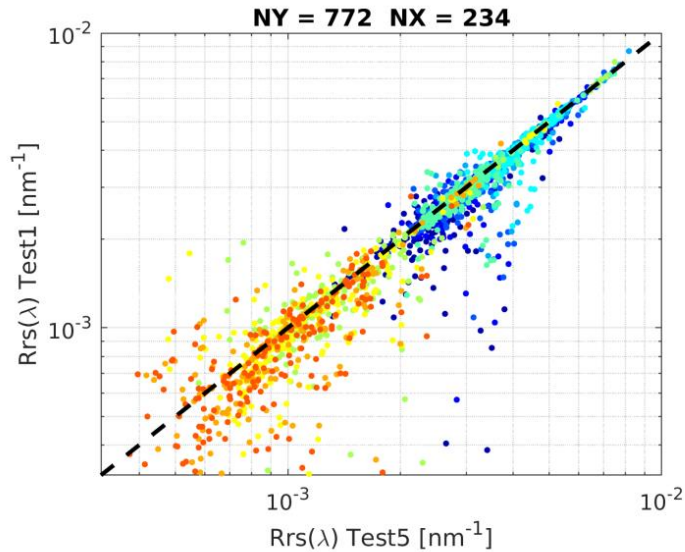
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# Entire Cruise

- 1: No QC + 50% Lt + Mobley Glint
- 5: Basic QC + 50% Lt + Mobley Glint
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+ SimSpec NIR



# Summary

- Many challenges - Is underway data “quality”?
  - Collected under non-ideal conditions
  - HyperInSPACE adapts to conditions & filters using field info
  - Transparent, shareable, and traceable
  - Still need to validate; match to station in-water data
- Is HyperInSPACE ready?
  - We need beta testers. Contact me.
- What's next?
  - BRDF correction and uncertainty budgets need improvement (not just in HyperInSPACE)
  - Add in OC product retrievals (Kd, Chl, GIOPs, QAA, etc.)
  - Should grow to accommodate more instrument suites (DALEK, WISP, Trios, Hypernets, ...?)



Configuration: KORUS.cfg

☐ Enabled

Frame Type:

ShutterLight

**Level 1A Processing**

Raw binary to HDF5

Solar Zenith Angle Filter

☒ SZA Max 65.0

**Level 1B Processing**

Apply factory calibrations

**Level 1C Processing**

Filter on pitch, roll, yaw, and azimuth

Rotator Home Angle Offset 0.0

Rotator Delay (Seconds) 60.0

Pitch & Roll Filter ☒

Max Pitch Angle 5.0  
 Max Roll Angle 5.0

Absolute Rotator Angle Filter ☒

Rotator Angle Min -20.0  
 Rotator Angle Max 45.0

Relative Solar Azimuth Filter ☒

Rel Angle Min 90.0  
 Rel Angle Max 135.0

**Level 1D Processing**

Data deglitching and shutter dark corrections

Deglitch Data ☒

Window for Darks (odd) 9  
 Window for Lights (odd) 11  
 Sigma Factor Darks 2.7  
 Sigma Factor Lights 3.7

Launch Anom. Anal. to test params on L1C. Save config after updating params. Results saved to /Plot/L1C\_Anoms.

Waveband interval to plot (integer): 3

Anomaly Analysis

**Level 1E Processing**

Interpolation to common times and wavebands.

Interpolation Interval (nm) 3.5

Generate Plots (slow; saved in ./Plots/L1E/) ☐

Save SeaBASS text file ☒

SeaBASS Header File KORUS.hdr

**Level 2 Preliminary**

GMAO MERRA2 ancillary data are required for Zhang glint Zhang correction and can fill in wind for Ruddick glint. WILL PROMPT FOR EARTHDATA USERNAME/PASSWORD [Register here.](#)

Download Ancillary Models ☒

**Level 2 Processing**

Quality control filters, glint correction, temporal binning, reflectance calculation.

Eliminate where Lt(NIR)>Lt(UV) ☒

Max. Wind Speed (m/s) 7.0

SZA Minimum (deg) 20.0  
 SZA Maximum (deg) 60.0

Enable Spectral Outlier Filter ☒

Filter Sigma Es 5.0

Filter Sigma Li 8.0  
 Filter Sigma Lt 3.0

Enable Meteorological Filters ☒

Cloud Li(750)Es(750)> 5.0  
 Significant Es(480) ( $\mu\text{W cm}^{-2} \text{ nm}^{-1}$ ) 0  
 Dawn/Dusk Es(470/680)< 1.5  
 Rain/Humid. Es(720/370)< 1.095

Ensemble Interval (secs; 0=None) 300

Enable Percent Lt Calculation ☒

Percent Lt (%) 10.0

**Skyglint/Sunglint Correction (Rho)**

Default Rho 0.0256  
 Default Wind Speed (m/s) 5.0  
 Default AOD(550) 0.5  
 Default Salinity (psu) 34.0  
 Default SST (C) 25.0

☒ Ruddick 2006 Rho
 ☐ Zhang 2017 Rho
 ☐ Mobley 1999 Rho

NIR Residual Correction ☒

☐ Simple resid. Hooker 2003 (blue water)  
☒ Simil. Spec. Ruddick 2006 (turbid)

Remove Negative Spectra ☐

Add Weighted Satellite Bands:

AQUA ☒ Sen-3A ☐ V-NPP ☒  
 TERRA ☐ Sen-3B ☒ V-JPSS ☐

Generate Spectral Plots

Rrs ☒ nLw ☒ Es ☒ Li ☒ Lt ☒

Save SeaBASS text file ☒